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Developing Ceramic Matrix Composites Using Additively Manufactured Fiber-Reinforced Polymers

Additive method automates fiber placement in ceramic composites for strong, heat-resistant parts at lower cost.

Researchers at Purdue University have developed a technique for the manufacture of ceramic matrix composites that automates fiber orientation and placement. This technique provides a mold-less approach to producing complex shapes and allows greater control of local and global microstructure and thermal history of the precursor material when compared to traditional manufacturing techniques while also reducing tooling and manufacturing costs. This technology has uses in a wide range of composite applications, particularly those for which withstanding high temperatures is critical. Examples include brake discs, rocket engines, heat shields, and thermal protection systems for hypersonic vehicles and structures.

Advantages:

- Easier to manufacture complex part geometries

- Greater control over local and global microstructure

- Lower tooling/manufacturing costs

- Can be integrated into existing additive manufacturing processes using polymer-reinforced fibers

Applications:

- Ceramic brake discs

- Heat shields and thermal protection solutions

- Rocket engines

- Furnace chamber and component fabrication

Technology ID

2021-TRIC-69499

Category

Aerospace & Defense/Hypersonics & Propulsion Systems
Materials Science & Nanotechnology/Composites & Hybrid Materials
Automotive & Mobility Tech/Micromobility & Smart Urban Infrastructure

Further information

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Technology Validation:

This technology has been validated through small batch manufacturing and pyrolysis of complex shaped 3D printed parts including a hollow cylinder and converging-diverging nozzle.

Related Publication:

Romero, E.S., Barocio, E. & Trice, R.W. Evaluating Extrusion Deposited Additively Manufactured Fiber-Reinforced Thermoplastic Polymers as Carbon/Carbon Preforms. Appl Compos Mater (2023). https://doi.org/10.1007/s10443-023-10176-y

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